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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 10/628,318 | 07/28/2003 | Jeanette E. O'Hara | GMC 0047 PA/40320.52 | 4444 |

23368 7590 12/13/2006

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| EXAMINER | |
|---|---|
| CHUO, TONY SHENG HSIANG | |
| **ART UNIT** | **PAPER NUMBER** |
| 1745 | |

DATE MAILED: 12/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/628,318 | O'HARA ET AL. | |
| | Examiner | Art Unit | |
| | Tony Chuo | 1745 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *03 October 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-15,17-27 and 29-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *42-45* is/are allowed.

6)☒ Claim(s) *1-15,17-27 and 29-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 July 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Response to Amendment*

1. Claims 1-15, 17-27, and 29-45 are currently pending. Claims 16 and 28 have been cancelled. The 112 rejections of claims 11, 13, and 42 are withdrawn. The amended claims 42, 44 and 45 do overcome the previously stated 102 and 103 rejections. Therefore, the rejections for claims for claims 42, 44 and 45 are withdrawn. However, the amended claims 1 and 33 do not overcome the previously stated 103 rejections because the limitation after the "and/or" is not given patentable weight. Therefore, claims 1-15, 17-27, and 29-41 stand rejected under the following 103 rejections.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-15, 17-22, 29-31, 33, and 38-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isono et al (US 6365293) in view of Yasumoto et al (US 2003/0198860). Regarding claims 1, 9 and 31, the Isono reference teaches a device: fuel cell "100", comprising an electrochemical conversion assembly: anode "120", cathode "110" and solid polymer membrane "101", a first reactant input "fuel gas" and first product output "fuel gas" in communication with first flow field region: fuel gas

channels "141", a first porous diffusion media: gas diffusion layer "122", a second reactant input "air" and second product output "air" in communication with second flow field region: oxidizer gas channels "131", a second porous diffusion media: gas diffusion layer "112", a region of high water concentration "115B", a region of low water concentration "115A", a mesoporous layer: mixture layer "113" or "123" comprising a hydrophilic carbonaceous component: carbon black and a hydrophobic component: PTFE, a mesoporous layer occupying a greater portion of one of high water region and low water region relative to other of high water region and low water region; and a mesoporous layer that is carried along a reduced thickness portion of the diffusion media substrate and at least partially infiltrates at least one of the first and second diffusion (See Figure 6, column 6, lines 18-20, and column 12, lines 10-12). Examiner's note: Since the first and second diffusion media substrate are porous layers with irregularities on the surface, the mesoporous layer will at least partially infiltrate the diffusion media substrate on the micro-level. In addition, the reduced thickness portion is interpreted as along the entire length of the diffusion media substrate since it is unclear as to where the reduced thickness portion is located with respect to the non-reduced thickness portion. Regarding claim 2, the Isono reference teaches a ratio of the area of the water permeation suppressing part "24A" to the entire area of the gas diffusion layer "24" within 10 to 90%. The area of the water permeation part "24B" would also be 10-90%. In this case, the area of the water permeation suppressing part is the low water region and the area of the water permeation part is the high water region. Therefore, the mesoporous layer or mixture layer would be confined to one of

high water region and low water region (See column 6, lines 18-20). Regarding claims 3-5, the Isono reference teaches a mixture layer with higher water permeability at the high water region "24B" to enhance the water transfer properties of the gas diffusion layer along the portion of the major face occupied by the mixture layer (See Figure 3 and column 5, lines 30-37). Regarding claims 6-8, the Isono reference teaches a mixture layer with lower water permeability at the low water region "24A" to diminish water transfer properties of the gas diffusion layer along the portion of the major face occupied by the mixture layer (See Figure 3 and column 5, lines 30-37). Regarding claims 10 and 12, the Isono reference teaches a layer "115" comprising a gas diffusion layer "112" and mixture layer "113" where the water permeability is relatively low in an area closer to the entrance of the oxidizer gas and the water permeability is relatively high in an area closer to the exit of the oxidizer gas. The region of low water concentration is the area closer to the entrance of the oxidizer gas and region of high water concentration is the area closer to the exit of the oxidizer gas. The second reactant input is the area closer to the entrance of the oxidizer gas and the second product output is the area closer to the exit of the oxidizer gas on the cathode side of the fuel cell. The mixture layer also occupies a greater portion of the high water region near the second product output (See column 10, lines 41-46). Regarding claim 11, the Isono reference teaches a mixture layer that is configured to enhance $H_2O$ transfer properties of at least one of first and second gas diffusion layer along portion of major face occupied by the mixture layer; a region subject to relatively high $H_2O$ concentration that is proximate first reactant input in communication with anode side of device; and

mixture layer that occupies a substantially greater portion of high $H_2O$ region proximate first reactant input. Examiner's note: The region subject to relatively high $H_2O$ concentration that is proximate first reactant input can also be interpreted as a region proximate to first product output, second reactant input, or second product output due to lack of spatial orientation of the components of the fuel cell. Regarding claim 13, the Isono reference teaches a mixture layer that is configured to diminish $H_2O$ transfer properties of at least one of gas diffusion layers along portion of major face occupied by mixture layer; a region subject to relative low $H_2O$ concentrations that is proximate first product output in communication with anode side of device; and a mixture layer that occupies a substantially greater portion of low $H_2O$ region proximate first product output. Examiner's note: The region subject to relatively low $H_2O$ concentration that is proximate first product output can also be interpreted as a region proximate to first reactant input, second reactant input, or second product output due to lack of spatial orientation of the components of the fuel cell. Regarding claims 14 and 15, the Isono reference teaches two mixture layers "211" and "212" along a major face of one of the first and second gas diffusion layers. The mixture layer "212" that is configured to enhance water transfer properties of gas diffusion layer occupies a greater portion of the high water region at the exit of the oxidizer gas. The mixture layer "211" that is configured to diminish water transfer properties of gas diffusion layer occupies a greater portion of the lower water region at the entrance of the oxidizer gas. (See Figures 12A and 12B). Regarding claim 17, the Isono reference teaches a reduced thickness portion of the substrate that is sufficient to accommodate for an increase in diffusion media

thickness introduced by the mixture layer. Examiner's note: The diffusion media substrate is interpreted as being a reduced thickness along it's entire length. Therefore any additional thickness introduced by the mixture layer will result in an increase in the thickness of the diffusion media. Regarding claim 18, the Isono reference teaches a gas diffusion layer that comprises carbon paper which is a carbonaceous fibrous matrix (See column 6, lines 60-61). Regarding claim 19, the Isono reference teaches a mixture layer where the hydrophobic component comprises PTFE which is a fluorinated polymer (See column 12, lines 10-12). Regarding claim 20, the Isono reference teaches a mixture layer where the hydrophilic carbonaceous component comprises carbon black powder (See column 12, lines 10-12). Regarding claim 21, the Isono reference teaches a carbon black characterized by a surface area of 200-300 $m^2/g$ (See column 12, lines 35-36). Regarding claim 22, the Isono reference teaches a carbon black characterized by a surface area of 700-800 $m^2/g$ (See column 12, lines 10-11). In addition, it is inherent that a higher surface area carbon black would have a smaller mean particle size. Regarding claims 29 and 30, the Isono reference teaches a mixture layer that infiltrates at least one of the first and second diffusion media substrates to a depth of less than 10μm in the high $H_2O$ region and to a depth of less than 25 μm in the low $H_2O$ region. Examiner's note: The limitation of less than 10μm and less than 25 μm can be interpreted as being zero. Regarding claim 33, the Isono reference is applied to claim 1 for the reason stated above. In addition, it also teaches that the ratio of pores of the gas diffusion layer is small, i.e. low porosity, at the entrance part which is the low water region and the ratio of pores of the gas diffusion layer is large, i.e. high porosity,

at the exit part which is the high water region (See column 2, lines 11-17). Regarding claim 38 and 39, the Isono reference teaches a gas diffusion layer that is 200 μm in thickness which is between 100 μm and 300 μm in the high water regions and between 190 μm and 300 μm in the low water regions (See column 6, line 61). However, the reference does not expressly teach a moderate surface area carbon characterized by mean particle size of between about 15 nm and about 70 nm. The Yasumoto reference does teach a carbon black for a gas diffusion layer of a fuel cell that has a particle size of 35 nm (See paragraph [0141]). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Isono fuel cell to include a carbon black that has a particle size of 35 nm because it is commonly used in the production of gas diffusion layer for fuel cells.

4. Claims 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isono et al (US 6365293) in view of Yasumoto et al (US 2003/0198860) as applied to claims 1-15, 17-22, 29-31, 33, and 38-39 above and in further view of Fuglevand et al (US 6939636). The references do not expressly teach a mesoporous layer comprising about 80 wt% or between 75 and 85 wt% of carbonaceous component in the high water region. The Fuglevand reference does teach a mesoporous layer: micro-diffusion layer that has about 80% carbon content and 20% PTFE (See column 7, lines 35-36). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the mesoporous layer of the Isono fuel cell to include about 80% carbon content in order to increase the porosity of the mesoporous layer at the high water region.

5. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Isono et al (US 6365293) in view of Yasumoto et al (US 2003/0198860) as applied to claims 1-15, 17-22, 29-31, 33, and 38-39 above and in further view of Fuglevand et al (US 6939636). The references do not expressly teach a mesoporous layer comprising between about 90 and 95 wt% of carbonaceous component in the low water region. The Fuglevand reference does teach a mesoporous layer: micro-diffusion layer that has about 90% carbon content and 10% PTFE (See column 7, lines 47-48). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the mesoporous layer of the Isono fuel cell to include about 90% carbon content in order to decrease the porosity of the mesoporous layer at the low water region.

6. Claims 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isono et al (US 6365293) in view of Yasumoto et al (US 2003/0198860) as applied to claims 1-15, 17-22, 29-31, 33, and 38-39 above and in further view of Zuber et al (US 2002/0041992). However, the references do not expressly teach a mesoporous layer that defines a thickness of less than 20 μm in the high $H_2O$ region or a mesoporous layer that defines a thickness of between about 10 μm and about 40 μm in the low $H_2O$ region. The Zuber reference teaches a hydrophobic layer containing PTFE that is located on a diffusion media substrate wherein the thickness of this layer is between 12 to 15 μm (See paragraph [0060]). Examiner's note: The Zuber reference is relevant because it discloses a similar porous layer comprising a hydrophobic component that performs the same as the applicant's mesoporous layer of varying the water permeability of the gas diffusion structure. Therefore, it would be obvious to one of

ordinary skill in the art at the time the invention was made to modify the Isono fuel cell include a mesoporous layer that defines a thickness of less than 20 μm in the high $H_2O$ region and between about 10 μm and about 40 μm in the low $H_2O$ region in order to ensure optimum proton conductivity of the electrolyte by maintaining proper humidity and avoiding flooding of the pores of the anode and cathode.

7. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Isono et al (US 6365293) in view of Yasumoto et al (US 2003/0198860) as applied to claims 1-15, 17-22, 29-31, 33, and 38-39 above and in further view of Wood, III et al (US 6350539). The references do not expressly teach a structure defining a vehicle powered by the fuel cell. The Wood reference does teach a fuel cell that produces power for vehicle propulsion (See column 1, lines 5-9). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the Isono fuel cell for producing power for a vehicle so that it can be used in a practical application.

8. Claims 34-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isono et al (US 6365293) in view of Yasumoto et al (US 2003/0198860) as applied to claims 1-15, 17-22, 29-31, 33, and 38-39 above and in further view of Johnson et al (US 5840438). The references do not expressly teach a gas diffusion layer with a porosity of up to 90% in the high porosity region, a porosity of between 70% and 75% in the low porosity region, a porosity of above about 70% in the high water region, and a porosity of between 70% and 75% in the low water region. The Johnson reference teaches that a typical gas diffusion layer is made of a carbon fiber paper with a porosity of

approximately 70% that would be used in the high porosity region, low porosity region, high water region, and low water region (See column 1, lines 22-28). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the gas diffusion layer of the Isono fuel cell to include a carbon paper with a porosity of about 70% because it's a readily available material.

9. Claims 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isono et al (US 6365293) in view of Yasumoto et al (US 2003/0198860) as applied to claims 1-15, 17-22, 29-31, 33, and 38-39 above and in further view of Mussell et al (US 5620807). The reference do not expressly teach a gas diffusion layer with a mean pore size of above about 20 μm in the high water region and less than about 25 μm in the low water regions. The Mussell reference does teach a gas diffusion layer with two regions of different mean pore sizes: 0.1-10 μm in small pore region and 30 μm in the large pore region (See Figure 1, column 5, lines 41-44, column 6, lines 1-2). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the gas diffusion layer of the Isono fuel cell to include a mean pore size of above about 20 μm in the high water region and less than about 25 μm in the low water regions in order to increase the porosity of the high water region and decrease the porosity of the low water region.

***Allowable Subject Matter***

10. Claims 42-45 are allowed. Regarding claims 42 and 43, the Isono reference discloses a mixture layer that is carried along at least a portion of a major face of one of

the first and second gas diffusion layers and comprises a hydrophilic carbonaceous component and a hydrophobic component. However, Isono et al does not expressly teach a mesoporous layer comprising a region of increased porosity relative to a remaining portion of the mesoporous layer wherein the region of increased porosity of the mesoporous layer occupies a substantially greater portion of the high water region relative to the low water region.

Regarding claims 44 and 45, Isono et al does not expressly teach a mesoporous layer at least partially infiltrates at least one of the first and second diffusion media substrates to a depth of greater than 0 microns to about 10 microns in the high water regions and a depth of greater than 0 microns to about 25 microns in the low water regions.

***Response to Arguments***

11. Applicant's arguments filed 10/3/06 have been fully considered but they are not persuasive. The applicant argues that Isono et al fails to teach a mesoporous layer carried along a reduced thickness portion of the first and second diffusion media substrates. The reduced thickness portion of the first and second diffusion media substrate is still interpreted as being along the entire length of the diffusion media substrate. Therefore, claims 1 and 33 still read on the Isono reference because limitation after "and/or" is not given patentable weight.

***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony Chuo whose telephone number is (571) 272-0717. The examiner can normally be reached on M-F, 8:30AM to 5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's trainer, Susy Tsang-Foster can be reached on (571) 272-1293. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TC

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